

What is claimed is:

1. A calcium phosphate body wherein the body is an calcium phosphate agglomerate, the agglomerate being a product of an agglomeration as a plurality of water-soluble glass bodies is transformed into a plurality of calcium phosphate bodies.

2. The agglomerate of claim 1 wherein the agglomerate contains at least about 10 calcium phosphate bodies.

3. The agglomerate of claim 1 wherein the agglomerate has a width of at least about 1 μm .

4. The calcium phosphate body of claim 1 wherein the body is an calcium phosphate agglomerate, the agglomerate being a product of an agglomeration as a plurality of water-soluble glass bodies is sintered into an agglomerate and subsequently transformed into an agglomerate of calcium phosphate bodies.

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5. The calcium phosphate body of claim 1 wherein the body is hollow.

6. The calcium phosphate body of claim 1 wherein the body is porous.

7. The calcium phosphate body of claim 1 wherein the body is hollow and porous.

8. A process for making a calcium phosphate body comprising contacting a water-soluble glass body in the form of a sphere with a diameter of less than about 1 μm , fiber, flake or ellipsoid and a phosphate solution wherein the water-soluble glass body contains about 1 to about 40 wt.% CaO, about 5 to about 65 wt.% alkali metal oxide component and about 20 to about 94 wt.% of a glass former.

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9. The process of claim 8 wherein the water-soluble glass body contains about 15 wt.% of CaO.

10. The process of claim 8 wherein the alkali metal oxide component is Li_2O , Na_2O , K_2O , Rb_2O , Cs_2O or mixtures thereof.

11. The process of claim 8 wherein the alkali metal oxide is Li_2O .

12. The process of claim 8 wherein the water-soluble glass body contains about 10 to about 15 wt.% CaO and about 8 to about 15 wt.% of the alkali metal oxide wherein the alkali metal oxide is Li_2O .

13. The process of claim 8 wherein the glass former is B_2O_3 .

14. The process of claim 8 wherein the water-soluble glass body contains about 10 to about 15 wt.% CaO and about 8 to about 15 wt.% of the alkali metal oxide wherein the alkali metal oxide is Li_2O , and containing about 70 to about 82 wt.% of B_2O_3 .

15. The process of claim 8 wherein the calcium phosphate is amorphous calcium phosphate or hydroxyapatite.

16. The process of claim 8 wherein the water-soluble glass body and the phosphate solution are contacted for a time ranging from about 1 hour to 2 weeks.

17. The process of claim 8 wherein the water-soluble glass body and the phosphate solution are contacted for a time ranging from about 4 hours to 24 hours.

18. The process of claim 8 wherein the water-soluble glass body and the phosphate solution are contacted at a temperature of about 20°C to about 90°C.

19. The process of claim 8 wherein the water-soluble glass body and the phosphate solution are contacted at a temperature of about 37°C.

20. The process of claim 8 wherein the phosphate solution has a pH of about 7 to about 10.

21. The process of claim 8 wherein the phosphate solution has a pH of about 9.

22. The process of claim 8 wherein the phosphate solution has a concentration of about 0.001M to 1.0M.

23. The process of claim 8 wherein the phosphate solution has a concentration of about 0.25M.

24. The process of claim 8 wherein the water-soluble glass body and the phosphate solution are contacted at a temperature of about 37°C for a time of about 24 hours and the phosphate solution has a concentration of about 0.25M and a pH of about 9.

25. A process for making an agglomerate of calcium phosphate bodies comprising contacting a plurality of water-soluble glass bodies with a phosphate solution and allowing the calcium phosphate bodies to fuse together as the water-soluble glass bodies are transformed to calcium phosphate bodies.

26. The process of claim 25 wherein the water-soluble glass bodies contain about 1 to about 40 wt.% CaO, about 5 to about 65 wt.% alkali metal oxide component and about 20 to about 94 wt.% of a glass former.

27. A method for delivering a fluid comprising (a) heat treating a calcium phosphate body at a temperature between about 30°C and about 1500°C, (b) filling the calcium phosphate body with the fluid and (c) administering the calcium phosphate body filled with the fluid to a subject.

28. The method of claim 27 wherein the calcium phosphate body is heat treated at about 90°C to about 900°C.

29. The method of claim 27 wherein the calcium phosphate body is heat treated for about 0.5 hours to about 48 hours.

30. The method of claim 27 wherein a first rate of fluid release in a body of the subject is about 0.1 to about 16 µg/mL·h.

31. The method of claim 27 wherein a second rate of fluid release in a body of the subject is about 0.01 to about 1 µg/mL·h.

32. A method for separating a chemical species from a fluid containing the species by affinity chromatography comprising (a) contacting the fluid with a macroscopically smooth calcium phosphate body to adsorb the chemical species onto the calcium phosphate body, (b) separating the fluid from the calcium phosphate body and (c) desorbing the species from the calcium phosphate body.

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33. The method of claim 32 wherein the calcium phosphate bodies are packed into a chromatography column.

34. The method of claim 32 wherein the calcium phosphate bodies are packed into a high performance liquid chromatography column.

35. The method of claim 32 wherein the calcium phosphate bodies are packed into a gas chromatography column.

36. The method of claim 32 wherein the calcium phosphate bodies are packed into a liquid chromatography column.

37. The method of claim 32 wherein the calcium phosphate bodies are packed into a bed.

38. The method of claim 32 wherein the calcium phosphate bodies are swirled in a vessel with the fluid.

39. The method of claim 32 wherein the calcium phosphate bodies are packed into a column or bed and the fluid is passed through the column or bed once.

40. The method of claim 32 wherein the calcium phosphate bodies are packed into a column or bed and the fluid is passed through the column or bed in a continuous loop.

41. The method of claim 32 wherein the calcium phosphate body is a hydroxyapatite sphere.

42. The method of claim 41 wherein the hydroxyapatite sphere has a diameter of about 0.5 μm to about 90 μm .

43. The method of claim 41 wherein the hydroxyapatite sphere has a diameter of about 45 μm to about 90 μm .

44. The method of claim 41 wherein the hydroxyapatite sphere has a diameter of about 0.5 μm to about 45 μm .

45. The method of claim 32 wherein the calcium phosphate body is prepared by contacting a water-soluble glass body and a phosphate solution wherein the water-soluble glass body contains about 9 to about 20 wt.% CaO, about 15 to about 25 wt.% Na₂O and about 55 to about 76 wt.% B₂O₃.

46. The method of claim 45 wherein the water-soluble glass body contains about 9.3 wt.% CaO, about 20.7 wt.% Na₂O and about 70.0 wt.% B₂O₃.

47. The method of claim 45 wherein the water-soluble glass body contains about 17.1 wt.% CaO, about 18.9 wt.% Na₂O and about 64.0 wt.% B₂O₃.

48. The method of claim 32 wherein the chemical species to be separated is a protein, a nucleic acid, a polypeptide or biological products.

49. The method of claim 48 wherein the protein is BSA, lysozyme, or myoglobin.

50. The method of claim 32 wherein the calcium phosphate body has a specific surface area of about 50 to about 400 m²/g.

51. A method for use of a calcium phosphate body as a bone substitute comprising administering the calcium phosphate body to a subject.

52. The method of claim 51 wherein the calcium phosphate body contains a dopant of CO₃²⁻.

53. A method for use of a calcium phosphate body as a diagnostic imaging agent comprising (a) filling the calcium phosphate body with a gas, (b) heat treating the calcium phosphate body and (c) administering the gas filled calcium phosphate body to a subject.

54. The method of claim 53 wherein the gas is air, hydrogen, nitrogen, oxygen, helium, neon, argon or xenon.

55. A regular or irregular particle of hydroxyapatite prepared from molded or crushed water-soluble glass, other than glass containing 20-35 wt% CaO, 20-35 wt.% Na₂O, 0-10 wt.% P₂O₅ and 30-50 wt.% B₂O₃, transformed in a phosphate solution at a temperature of less than about 100°C.

56. The particle of claim 55 wherein the water-soluble glass has a ratio of B₂O₃ to alkali metal oxide component of about 2.5 to 1 to about 3.5 to 1.

57. The particle of claim 55 wherein the water-soluble glass has a ratio of B₂O₃ to alkali metal oxide component of about 2.5 to 1 to about 3.5 to 1.